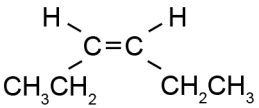
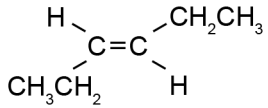
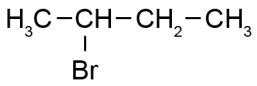
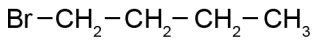
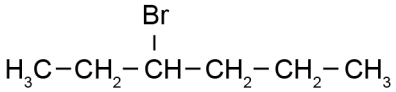
Assessment Schedule – 2021

Chemistry: Demonstrate understanding of the properties of selected organic compounds (91165)

Evidence

Q	Evidence	Achievement	Merit	Excellence
ONE (a)(i) (ii)	2 and 3 They have the same molecular formula, C_6H_{12}, but have a different order of connectivity of atoms / different arrangement of atoms, Compound 2 is cyclic / ring and Compound 3 is a straight chain	• Correct compounds identified. • Correct explanation.	• Links features of the structure of the compound.	
(b)(i)	 *Cis*  *Trans*	• Correctly identifies *cis* and *trans* isomers.		
(ii)	To form *cis* and *trans* isomers, a carbon-carbon double bond is required, and the atoms / groups on each of the C atoms of the double bond must be different. Compound 3 has a carbon-carbon double bond. This bond is rigid, so does not allow rotation to occur around it. Both structures also have two different atoms / groups on each of the C atoms of the double bond; an H atom and a CH_2CH_3 group.	• States the need for a carbon-carbon double bond AND two different atoms / groups on each C atom of the double bond.	• Explains why the carbon-carbon double bond AND two different atoms / groups on each C atom of the double bond are required.	• Fully justifies how the structural features of Compound 3 allow for geometric isomerism.

(c)	In both cases it is an addition reaction because the double bond is broken and two new atoms are added (a H and a Br atom). For **Compound 1**, there are two products because the alkene is asymmetric due to the position of the double bond. There are two unique positions the H and Br can bond to, so there are two possible products. The carbon of the double bond with the most hydrogens attached gains another hydrogen atom in the major product. This means that 2- bromobutane will be the major product, since C_1 has two hydrogens and C_2 has only one hydrogen; therefore C_1 gains another H, forming 2-bromobutane.  2-bromobutane  1-bromobutane For **Compound 3**, there is only one product because the alkene is symmetrical due to the position of the double bond. This means only 3-bromohexane can be formed. 	• Identifies the type of reaction. • Identifies that two products form from **Compound 1** and one product forms from **Compound 3**.	• Explains why it is an addition reaction. • Explains with limited detail why there are two products. OR Correctly draws the structural formula and identifies the major / minor products of **Compound 1**.	• Fully explains the addition reaction and the possible organic products of both **Compound 1** and **Compound 3**. Structures MUST be correct.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	3a	4a	2m	3m	2e (minor error)	2e

<table>
<tr><th>Q</th><th>Evidence</th><th>Achievement</th><th>Merit</th><th>Excellence</th></tr>
<tr>
<td>TWO
(a)(i)

(ii)</td>
<td>Compound C: $CH_3CHNH_2CH_2CH_3$
Compound E: $CH_3CHOHCH_2CH_3$
Compound H: $CH_3CHClCHClCH_3$

<table>
<tr><td></td><td>Reagent</td><td>Conditions</td></tr>
<tr><td>Reagent W</td><td>Br_2</td><td>UV light</td></tr>
<tr><td>Reagent X</td><td>HCl</td><td></td></tr>
<tr><td>Reagent Y</td><td>conc H_2SO_4</td><td></td></tr>
<tr><td>Reagent Z</td><td>H_2</td><td>Pt or Ni</td></tr>
</table>
Do not penalise heat / pressure when given.</td>
<td>• FOUR correct.</td>
<td>• SIX correct.</td>
<td>• NINE correct.</td>
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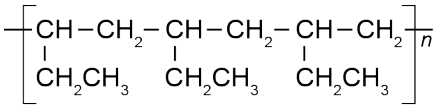
<tr>
<td>(b)(i)

(ii)</td>
<td> 
In an addition polymerisation reaction, C=C double bonds are broken in order for new bonds to form between monomers as they link into long repeating chains called polymers.
Compound F is unsaturated, as it contains a reactive C=C double bond, and is therefore able to undergo this reaction type. Compound A is saturated, so only contains unreactive C–C single bonds, and therefore is unable to undergo this type of polymerisation.</td>
<td>• Correct polymer.
• Identifies A is saturated / (C-C), or F is unsaturated / (C=C).
• Partial explanation of addition polymerisation.</td>
<td>• Links saturated / (C-C), nature of A / unsaturated / (C=C) nature of F to reactivity.
• Explains addition polymerisation.</td>
<td>• Fully explains difference of A and F to undergo addition polymerisation with reference to structure and reactivity with correctly drawn polymer.</td>
</tr>
<tr>
<td>(c)</td>
<td>Ethanamine / aminoethane
$CH_3CF_2CH_2CH_3$
$CH_3CH(CH_3)CH_2COOH$
Ethylpentane (3-ethylpentane)</td>
<td>• TWO correct.</td>
<td></td>
<td></td>
</tr>
</table>

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	3a	4a	2m	3m	2e (minor error)	2e

Q	Evidence	Achievement	Merit	Excellence
THREE (a)(i)	Propan-1-ol: Primary Methylpropan-2-ol: Tertiary 3-chloropentane: Secondary Ethanol: Primary	• THREE correct.		
(ii)	In Propan-1-ol, the hydroxyl group is bonded to a carbon atom that is directly bonded to 1 other carbon atom, making it a primary alcohol. In the case of methylpropan-2-ol, the carbon bearing the hydroxyl group is directly bonded to 3 other carbon atoms, making it a tertiary alcohol.	• Classification due to number of carbons bonded to carbon bearing hydroxyl group.	• Correctly compares the two classifications.	
(b)(i)	Add acidified potassium permanganate. Propan-1-ol will react to form propanoic acid, turning the purple permanganate colourless. $CH_3CH_2CH_2OH + MnO_4^- / H^+ \rightarrow CH_3CH_2COOH$ 3-chloropentane will not react.	• Identifies correct observation for BOTH reagents. OR Identifies ONE correct product.	• Correctly distinguishes ONE pairs of compounds with correct reagents, observations and structural formulae of the products. OR Correctly distinguishes TWO pairs of compounds with correct reagents, observations and names products only.	• Correctly distinguishes BOTH pairs of compounds with correct reagents, observations and structural formulae of the products.
(ii)	Add bromine water. Pent-1-ene will react to form 1,2-dibromopentane, turning the orange / brown bromine water colourless. $CH_2CH(CH_2)_2CH_3 + Br_2(aq) \rightarrow CH_2BrCHBrCH_2CH_2CH_3$ Propan-1-ol will not react (or will only slowly react in the presence of UV light).			
(c)	Add water to all samples. The one that forms two layers is pent-1-ene. The other two compounds are miscible in water. Slowly heat both remaining samples until you reach their boiling points. This will be when the liquid samples turn into gases. The one with the lower boiling point is ethanol / the higher boiling point is propan-1-ol. *No penalty for correctly using boiling / melting points to identify all 3 substances. Pent-1- ene < ethanol< propan-1-ol.*	• Identifies pent-1-ene using solubility. OR Identifies a difference in boiling point between ethanol and propan-1-ol.	• Correctly links physical properties to all 3 substances.	• Devises a method which allows for the correct identification of the 3 compounds.
(d)	When 3-chloropentane reacts with alcoholic KOH, pent-2-ene is formed. $CH_3CHCHCH_2CH_3$. This is an elimination reaction because the Cl atom and a H atom from a neighbouring carbon are removed to allow the formation of a carbon-carbon double bond. However, when 3-chloropentane reacts with aqueous KOH, pentan-3-ol is formed ($CH_3CH_2CHOHCH_2CH_3$). This is a substitution reaction, as the Cl atom is substituted for a hydroxyl / OH group.	• Correctly identifies product of ONE reaction. OR Correctly identifies ONE reaction type.	• Correctly explains ONE reaction type with reference to reaction occurring AND structural formula.	• Fully explains BOTH types of reaction under each condition with correct products.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	3a	4a	2m	3m	2e	3e

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 14	15 – 18	19 – 24